Queen Elizabeth Class (QEC) Aircraft Carrier
HMS QUEEN ELIZABETH and HMS PRINCE OF WALES
World's Largest Electric Propelled Warships

The new Queen Elizabeth Class will be the Royal Navy’s new aircraft carriers. The ships, at more than three times the displacement of the Invincible Class that it replaces, represents a step change in both size and capability. At 11kV, and >130MVA this is power and propulsion on a grand scale. However the ship uses a classical architecture and pull through: of equipment from other Naval and commercial platforms, so cost and risk is minimized.

Background
The UK MOD is procuring two new aircraft carriers for the Royal Navy, HMS Queen Elizabeth and HMS Prince of Wales, due to enter service from 2016. The new carriers will be the biggest and most powerful surface ships ever built for the Royal Navy with the 65000T ships representing a step change in the capability from the current 20,000T Invincible Class.

The Queen Elizabeth Class Carriers are the first RN ships to have been designed from the outset with integrated full electric propulsion (IPE) vessel, without legacy constraints, and reduced through life costs. The electric propulsion architecture has evolved with this clearly in mind. Graceful degradation rather than redundancy, minimum acceptable prime mover fit, maximizing the availability of a two shaft line solution have all been at the forefront of the design effort.

The Design Process
GE’s Power Conversion business has been involved in the Aircraft Carrier project since 2001, initially as part of the Thales team in the competition phase. The outcome of the competition resulted in the formation of the Aircraft Carrier Team (ACT) which then became the Aircraft Carrier Alliance (ACA). Thales, as the PSP provider within the ACA, selected Power Conversion as a preferred partner for the HV, Propulsion and System Integration elements of the Power & Propulsion (P&P) System. During the Demonstration phase to the end of 07, a significant amount of value engineering, design maturity and integration has taken place in preparation for the Manufacturing phase which was given the green light in July 07 by the UK government. The Manufacturing Phase continued through 2012 with a formal Sub-Alliance being formed between Power Conversion, Thales, Rolls Royce and L3 in October.

System Configuration
The arrangement for the QEC HV Power and propulsion system features four HV switchboards at 11kV (2 fwd and 2 aft), two Rolls Royce MT30 Gas Turbines and Four Wartsila Diesels all driving Power Conversion Generators. Three of the HV switchboards provide propulsion, with the two aifter switchboards each supplying one motor and the fwd GT board supplying the other two motors, so 50% of the propulsion and services is supplied fwd, and 50% aft. The fwd port island can be used as a ‘Clean island’ for ship services if required.

The propulsion motors and converters are Power Conversion’s Advanced Induction Motors (AIMs) and VDM25000 Converters as fitted to T45, with minor changes due to being transformer fed from the Aircraft Carrier’s 11kV system in a 24 pulse arrangement.
The four propulsion motors are almost identical to those used on the Royal Navy’s Type 45 destroyers, apart from the fact that they are arranged in a ‘twin’ arrangement with one behind the other on each shaftline. At her home port the Queen Elizabeth Class will take on shore power at the 11kV level, via plugs and sockets connected directly to the HV system.

There has been a strong Power Conversion presence co-located with Thales in Bristol since the early days of the project. They have been principally involved in integration issues on not only the whole power and propulsion system, but also the Power Management system (EPCAMS) provided by Power Conversion under contract to Thales.